Claims

1. Method for depositing titania, or titania-containing as thin films on a substrate, the method comprising the steps of :
   - using an atmospheric pressure glow discharge plasma as a major source of reaction to improve film properties and film growth rates, when the substrate is heated at a temperature below 250°C,
   - introducing a reactive titania CVD precursor which has been pre-vaporised into the introduced gas flow into a gas flowing through a coating region,
   - forming thin film, the said film is photo-active, demonstrated by their ability to destroy organic materials on the surface and/or to modify the surface energy on irradiation with UV or visible light.
2. Method according to claim 1 wherein a post treatment of the coating with an atmospheric glow discharge plasma modifies the film properties and structure.
3. Method according to claim 2 wherein the post treatment modifies the film stoichiometry allowing control of film properties.
4. Method according to claim 1 wherein a laminar flow is introduced into, and through the coating zone.
5. Method according to anyone of the claims 1 to 4 wherein an extraction system is employed to control gas flow through the coating zone which supports controlled flow.
6. Method according to anyone of the preceding claims wherein a thermal control system is designed into the coating zone to maintain the substrate temperature at the desired level, said thermal control system can be achieved by a range of techniques including gas or water or liquid coolant based cooling, or combinations thereof.
7. Method according to claim 6 wherein the thermal control system is designed to cool the coating zone to reduce unwanted side reactions.
8. Method according to claim 1 wherein the reactive titania CVD precursor which is introduced in the coating zone is an alkoxide of titanium or titanium tetrachloride.

9. Method according to anyone of the preceding claims wherein films can be deposited with a uniformity of at least +/- 20 % and preferably a uniformity of at least +/- 10 % and more preferably better than +/- 5%.
10. Method according to anyone of the preceding claims wherein it can be used to build up a thicker layer or layers of different composition by arranging sequential coating regions along a direction of movement of the substrate.
11. Method according to anyone of the preceding claims wherein it can be used in combination with different coating method.
12. Method according to claim 1 wherein the glow discharge plasma is generated, between metal electrodes, by a low frequency e.g. AF or RF source where the frequency is below 100KHz and preferably below 30Khz
13. Method according to claim 12 wherein the metal electrodes are selected from a material which reduces heat generation
14. Method according to claims 12 or 13 wherein the electrodes are made of brass.
15. Method according to anyone of the preceding claims wherein the power density of the plasma is below 5 Wcm^{-2} and preferably below $1Wcm^{-2}$ and more preferably below 0.5 Wcm^{-2}.
16. Method according to anyone of preceding claims, wherein the peak growth rate is at least 10 nm per second, and up to several tens of nm per second, over 100nm per second.
17. Method according to anyone of preceding claims, wherein the film can be deposited on preformed and/or thermally toughened substrates
18. Method according to anyone of preceding claim, wherein the film can be deposited on a wide range of temperature sensitive substrates including thermally preformed substrates and plastic substrate materials.
19. Method according to anyone of preceding claims, wherein a level of water and oxygen are controlled carefully to achieve target growth rates and to control unwanted side reactions, the oxygen level being below 5% and more preferably below 1%, the water vapour levels being controlled preferably below 1% and more preferably below 0.1%
20. Method according to claim 19, wherein it is suitable for coating moving substrates – both as continuous film or sheet, or a series of substrates supplied semi-continuously.

21. Method according to anyone of preceding claims, wherein one or more gas flushing zones is used to allow the introduction, and removal, of the substrates whilst maintaining the integrity of the coating region gas composition.

22. Substrate according to claim 21, wherein the film is crystallized

23. Substrate according to claim 22, wherein the deposited film has a good optical quality suitable, and having an absorption levels, which is low typically from a few % to less than 1, for use on substrates which are required to be substantially transparent to the human eye and to be looked through.